2015/2016 Summer Studentship Project Application Form

Send to: Research Office, University of Otago Christchurch, PO Box 4345, Christchurch, by 5pm on **3 July 2015**

Supervisor Information (First named supervisor will be the contact):	
Supervisor's Name and Title(s): Dr Jennifer Dunn, Dr Shayne Gooch, Prof Alastair Rothwell.	
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Research Category (Choose one category only – to be used for judging the students' presentations):		
Clinical X	**Laboratory**	**Community**

Project Title (20 words MAXIMUM):

Measurement of elbow extensor strength; development and testing of the Troidometer II

Project Description:

Introduction:

Assessment of muscle strength is an important component of neurological examination and is often essential in planning and evaluating medical and surgical interventions. Manual muscle testing (MMT), in which muscle strength is typically assessed on the MRC 0 -5 scale has been in use for many decades because of its convenience and international recognition. The inaccuracies and subjective nature of the technique are widely acknowledged - specifically the inter-subject variability and the wide, difficult to quantify gaps between grades 3 and 4, and grades 4 and 5.[1]

Following cervical spinal cord injury (SCI), paralysis of several upper limb muscles occurs which consequent loss of upper limb function. There are surgical procedures that can restore some of this lost upper limb function. One such procedure is the posterior deltoid to triceps transfer that aims to provide active elbow extension when the triceps has been paralysed.[2] Whilst improvement in the MRC grade is demonstrated following surgery it is difficult to quantify this strength due to the inaccuracies of MMT as the majority gain strength between grades 3 and 4.

In the early 1990s we developed a dynamometer for measuring muscle torque, measured in newton metres, known as the Troidometer. The Troidometer concept was verified in a laboratory setting and found to be reliable for measuring elbow extension torque and in addition the elbow extension torque of a number of people with SCI's was also successfully measured following deltoid-triceps transfer surgery.[3] Further work is now required to evolve the Troidometer concept further to enable more accurate and efficient measurements and improve ease of use in a general clinical situation. This will require refinements to the data acquisition system so that results can be captured and analyzed using modern software and hardware e.g. current operating systems and a laptop/tablet/smartphone. Ultimately, the Troidometer II will be used to more accurately quantify regained elbow extension strength following deltoid-triceps transfers in a clinical setting with minimal clinician training and instruction required. However prior to this, the device needs be tested on a group of normal individuals to establish the test procedure, to determine repeatability (consistency of measurements), and clinical utility (ease of use in a clinical setting).

Aim: The project will have three aims:

1) To modify the Troidometer to improve the ergonomic use by the subject and the clinician. This includes incorporating modern data acquisition and processing methods.
2) To develop and test protocols for measuring elbow extension torque in a cohort of normal subjects to determine test-retest and inter-rater reliability

3) To determine the testing positions of the elbow that provide an accurate representation of an individual's torque. (clinical utility).

Method:

1) Modification/development of Troidometer II
   Measure the arm extension capability of at least two normal subjects and capture results using the Triodometer I. Obtain feedback from clinicians to establish modifications required to improve the ergonomic and functional properties of the Triodometer I. Then develop the manufacturing instructions and oversee the alterations required to produce the Triodometer II. Establish and implement a modern data acquisition system for measuring, recording and processing the data obtained from the Triodometer II. Technician assistance will be available to help with practical aspects of the project.
2) Testing protocols
   The student will perform a literature search on testing protocols for isometric muscle testing and develop testing protocols for the Troidometer. followed by testing a cohort of 20 normal subjects on two occasions to determine reliability of the device.

3) Determine clinical utility
   The student will analyse the results of the testing to determine the minimum number of testing positions required to provide accurate representation of an individual's strength so that it is useful in a clinical setting.

References:

1. James, M.A., *Use of the Medical Research Council muscle strength grading system in the upper extremity.* The Journal of hand surgery, 2007. **32**(2): p. 154-156.
2. Dunkerley, A.L., A. Ashburn, and E.L. Stack, *Deltoid triceps transfer and functional independence of people with tetraplegia.* Spinal Cord, 2000. **38**: p. 435-41.
3. Lieber, R., et al., *Analysis of posterior deltoid function one year after surgical restoration of elbow extension.* Journal of Hand Surgery, 2003. **28A**: p. 288-93.

Student Prerequisites (eg. Medical Student) if applicable:
Engineering student